

Air Force Civil Engineer Center



**FORMER
WILLIAMS AIR FORCE BASE
Site ST012
Former Liquid Fuel
Storage Area**

**BCT Conference Call
13 December 2018**



Site ST012 Outline

- Summary of activities since Nov BCT call
- Update on SVE system (JP-4 equivalent of methane)
- LNAPL monitoring/removal update
- Update on regression analysis for BTEX compounds
- Summary of November groundwater monitoring benzene results
- Pilot study extraction/injection update
- Path forward



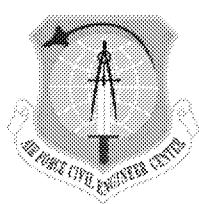
Site ST012 Activities Since November

- Continued SVE operation
- Continued LNAPL screening in accessible wells
- Annual groundwater sampling event (plus select perimeter wells)
- Operation of Extraction and Treatment
 - Perform pump maintenance and repair as needed
 - One new pneumatic pump installed
 - One new pneumatic pump hose repaired
 - One replacement electrical submersible pump installed (still down on electrical error)
 - Four additional pumps on order

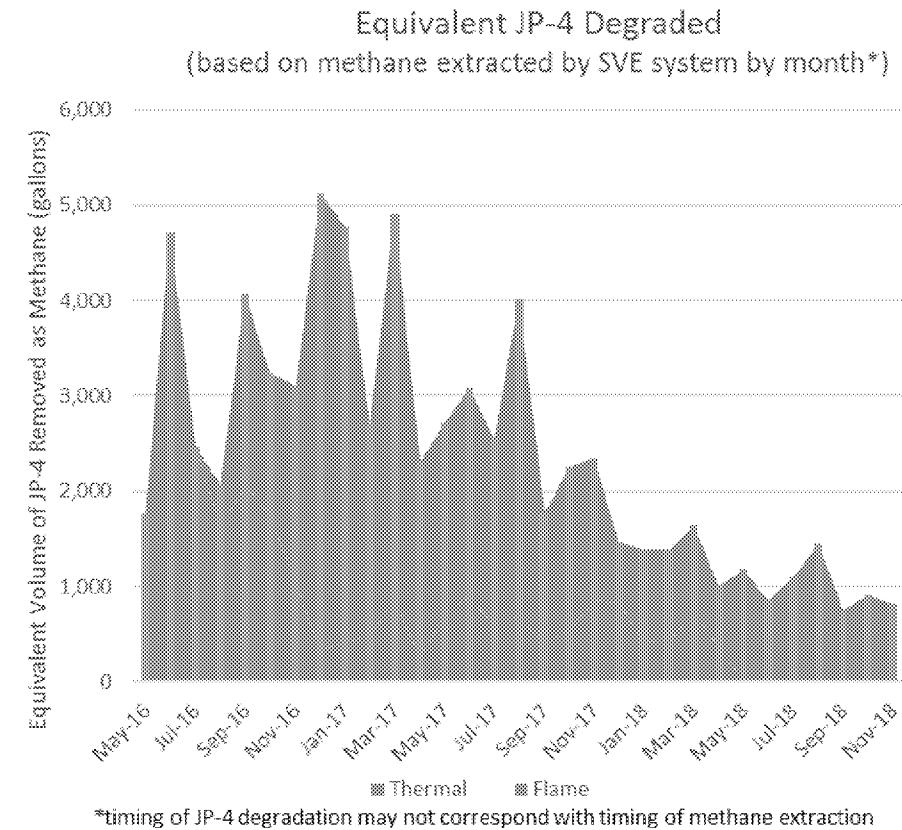
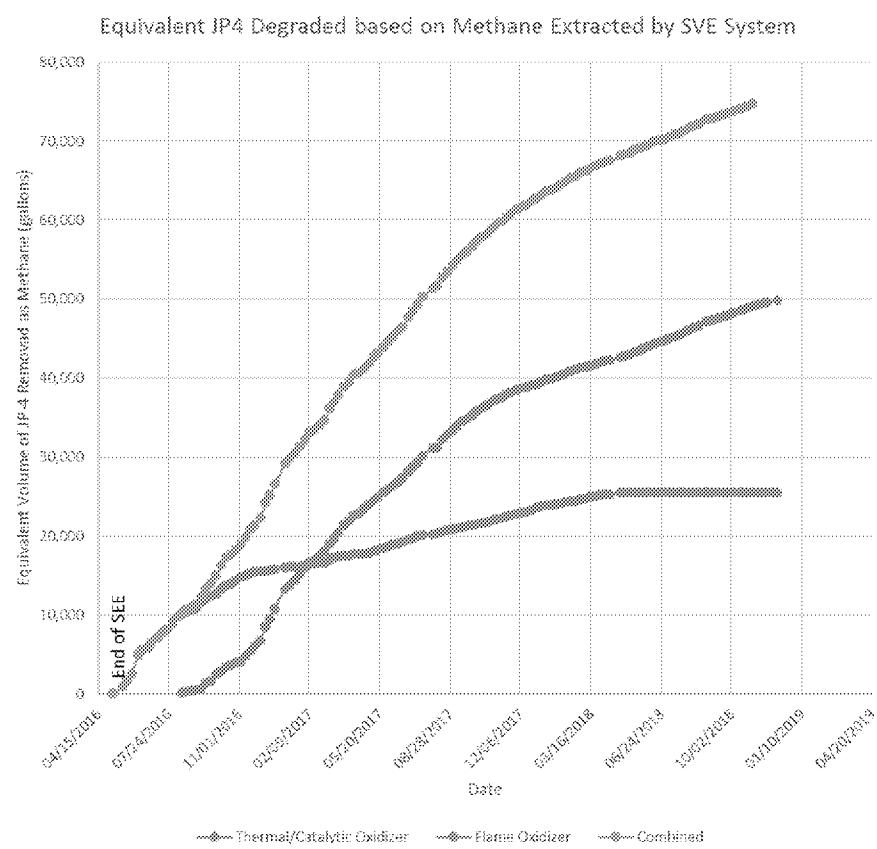




JP-4 Degradation Based on Methane Removed with SVE (through 6 Dec)



Site ST012 SVE System Equivalent JP-4 Degradation Based on Methane Removed



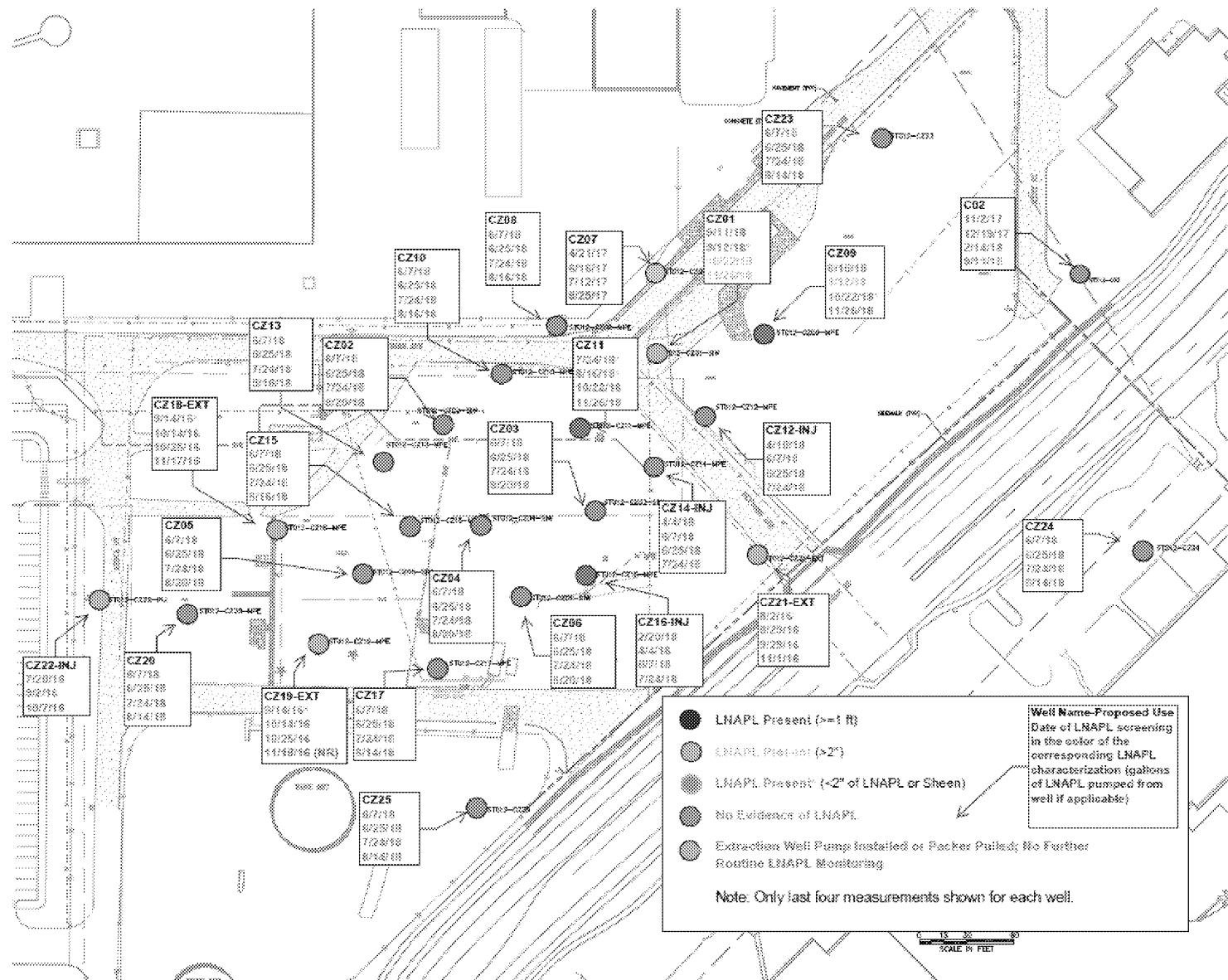
- Estimates revised down from previous reports due to change in formula used for SVE flow rates at oxidizers (will affect previously presented TPH summaries as well)
- Estimates through 6 Dec 2018.
- Estimated JP-4 degradation as methane is in addition to JP-4 removal reported for SVE
- Thermal oxidizer changed from SVE to groundwater treatment end of Apr
- Recent equivalent JP-4 degraded ~7,000 pounds per month (~1,000 gallons per month)



LNAPL Monitoring Update (through 10 Dec)

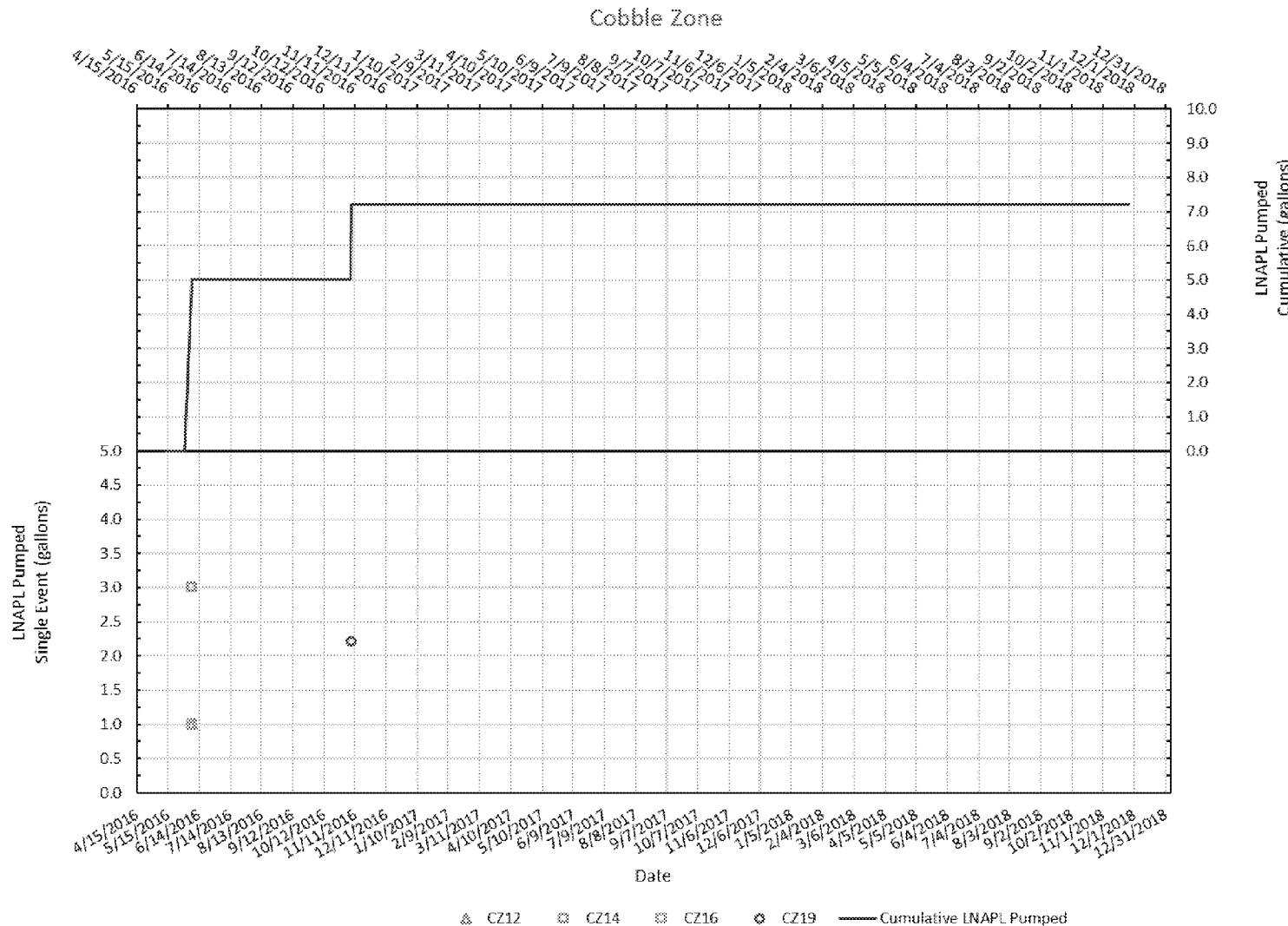


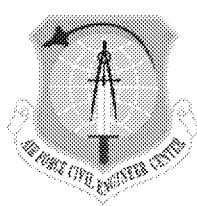
LNAPL Monitoring/Removal Status Cobble Zone



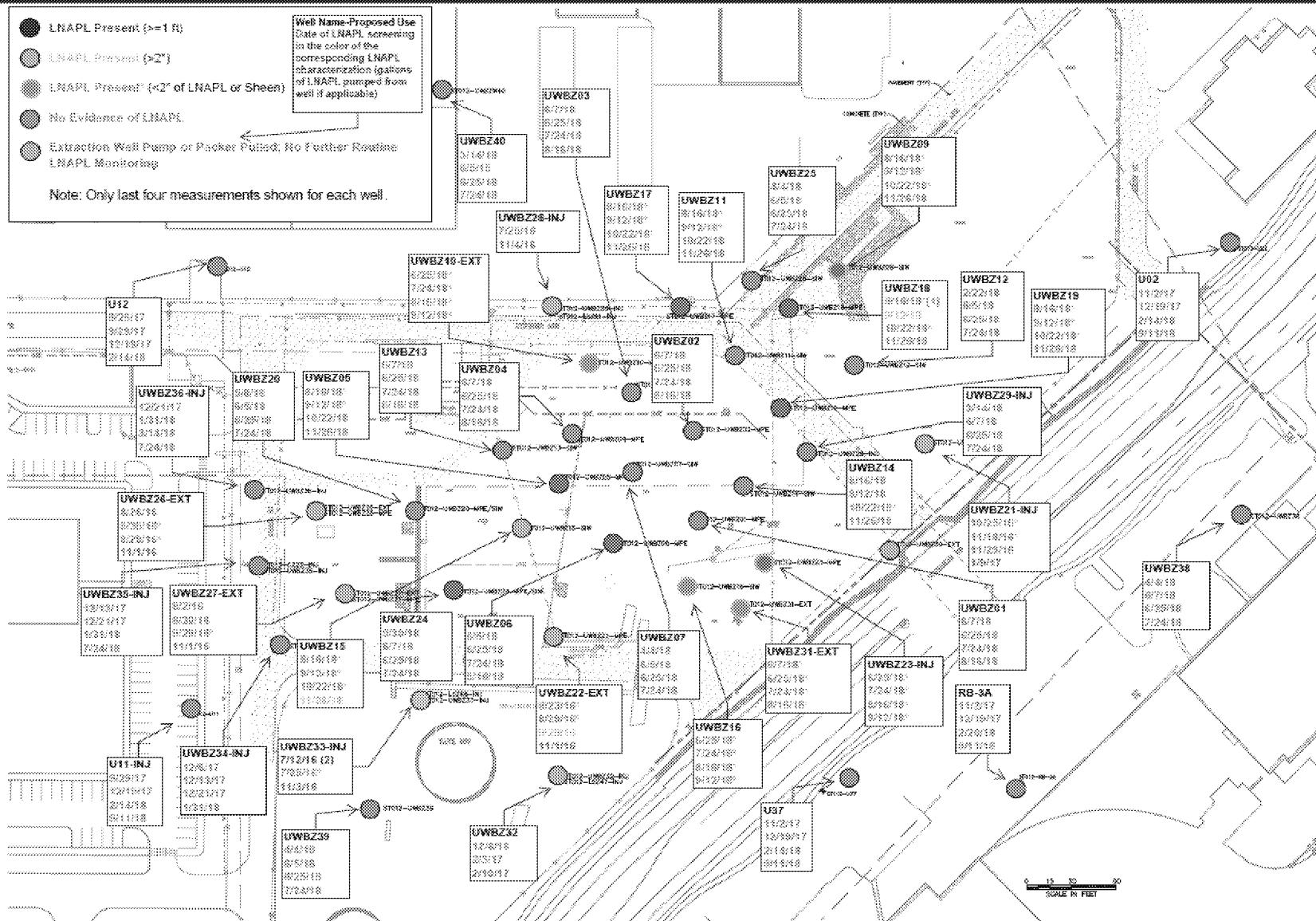


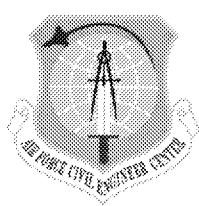
LNAPL Monitoring/Removal Status Cobble Zone



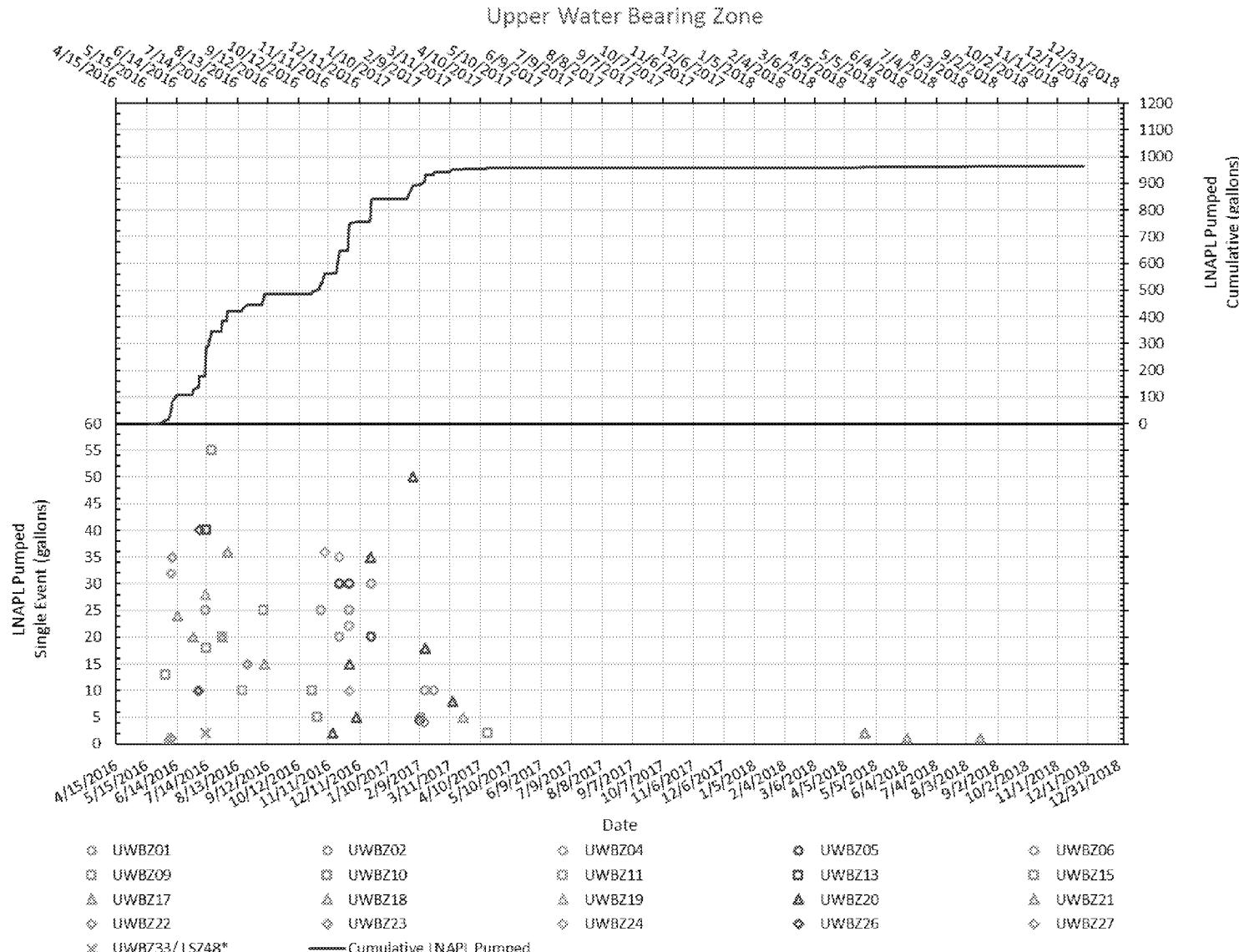


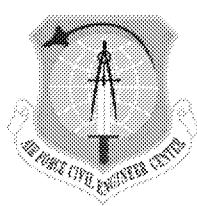
LNAPL Monitoring/Removal Status Upper Water Bearing Zone





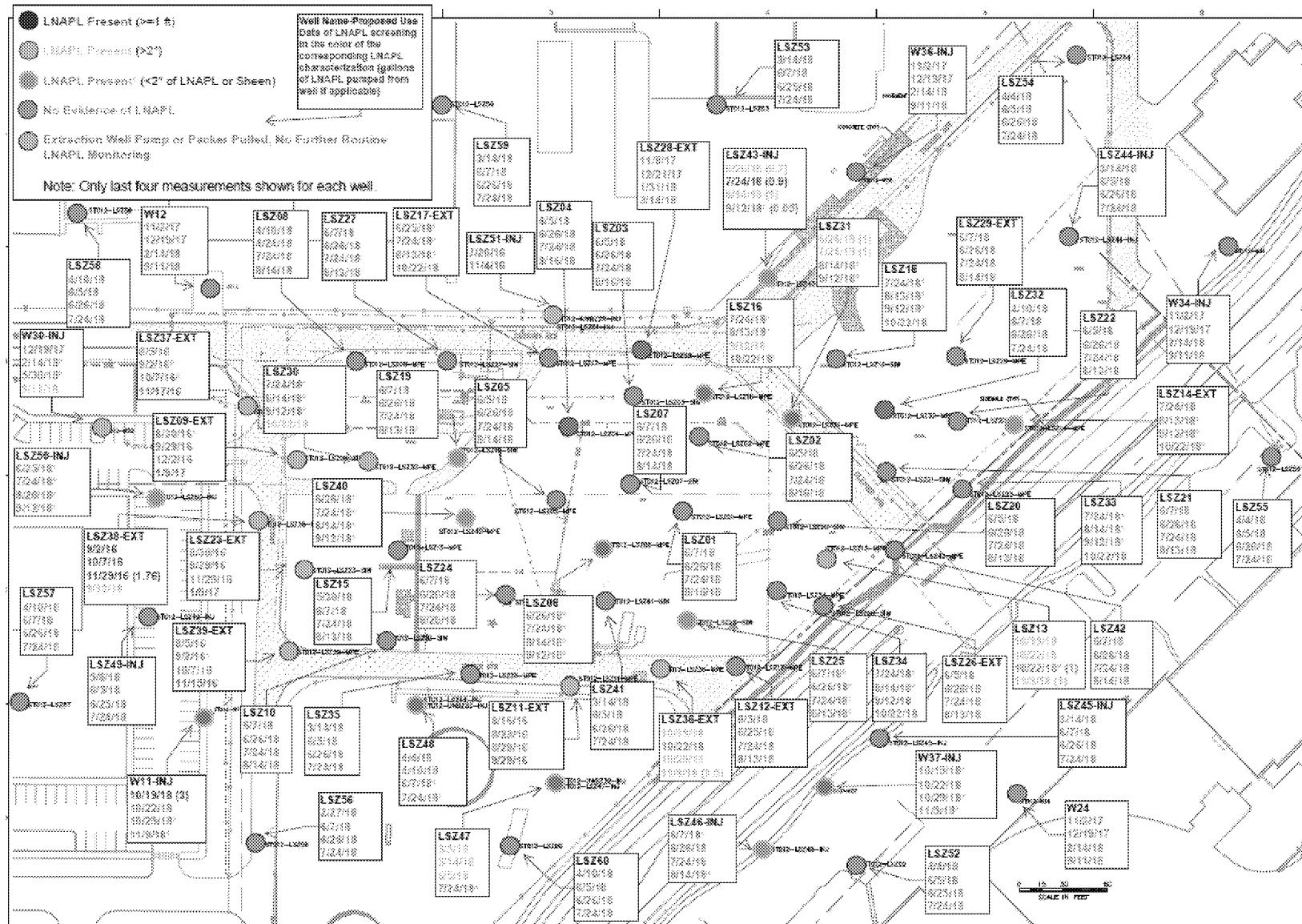
LNAPL Monitoring/Removal Status Upper Water Bearing Zone

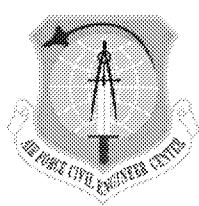




LNAPL Monitoring/Removal Status

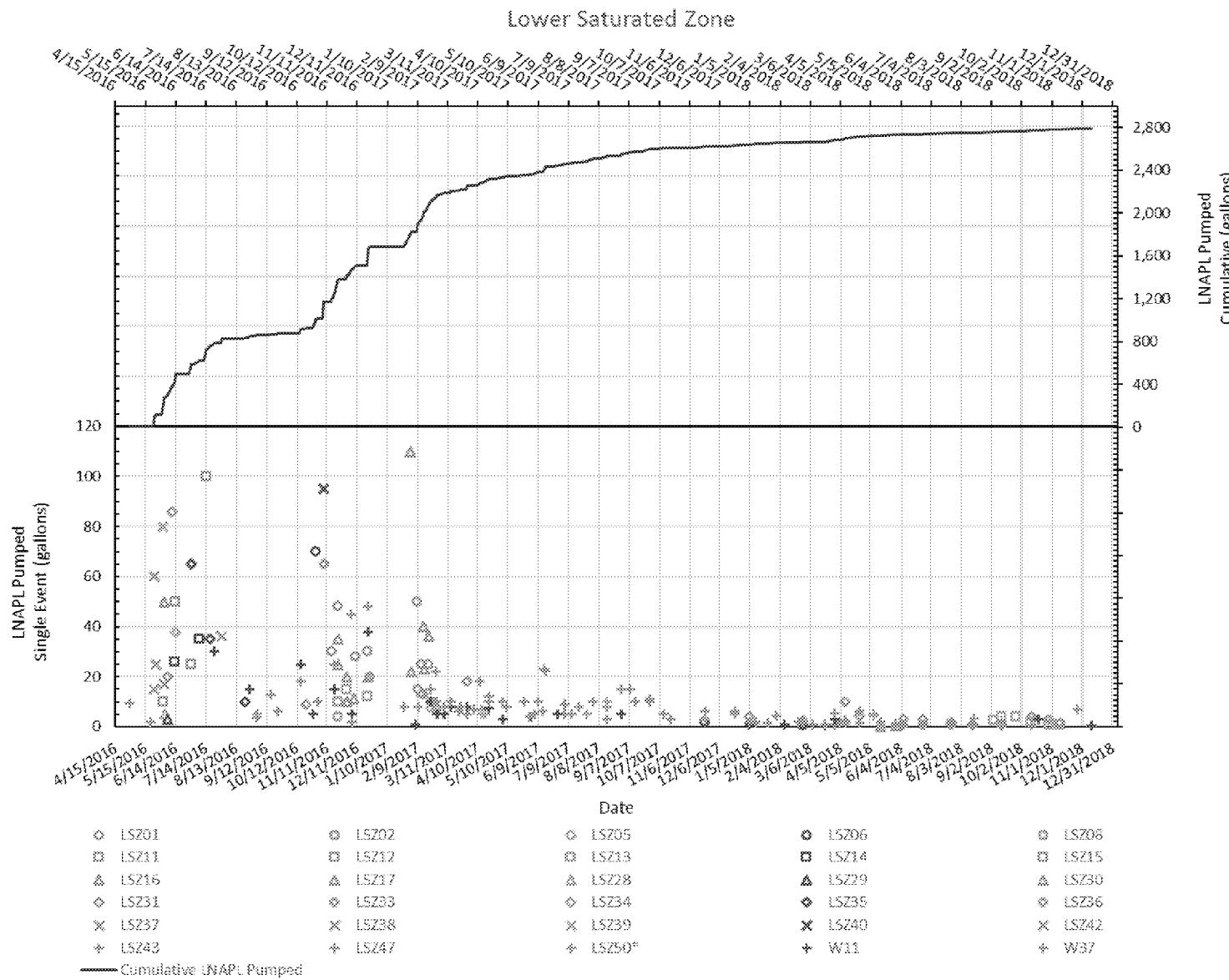
Lower Saturated Zone

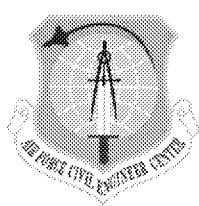




LNAPL Monitoring/Removal Status

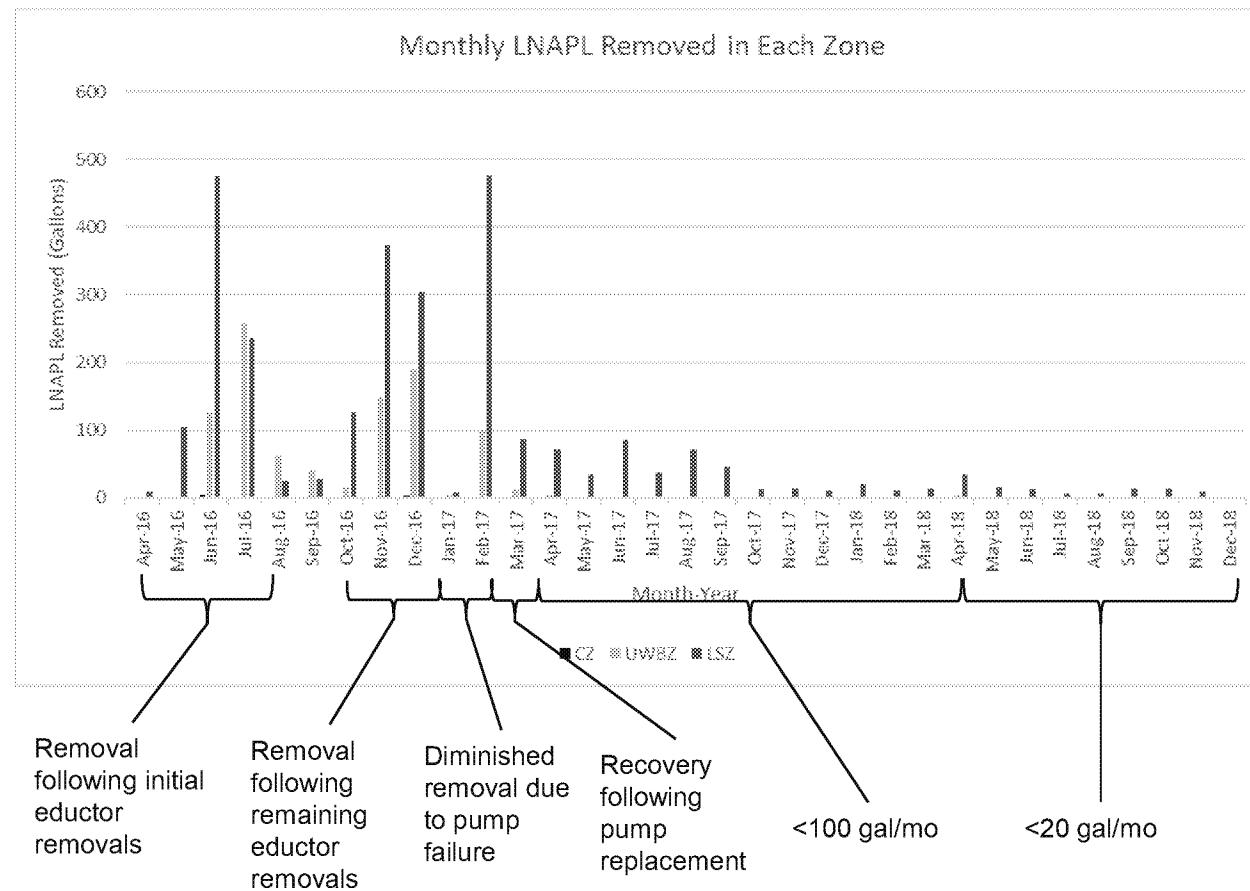
Lower Saturated Zone





ST012 LNAPL Monitoring/Removal Summary

- CZ – 7 gallons of LNAPL removed. None since Nov 2016
- UWBZ - 962 gallons of LNAPL removed. None removed since Sep update
- LSZ - 2,789 gallons of LNAPL removed. 8 gallons removed since Nov update (W11, LSZ43).





Update on Statistical Correlation Evaluation for BTEX and TEAs



Statistical Correlation Update

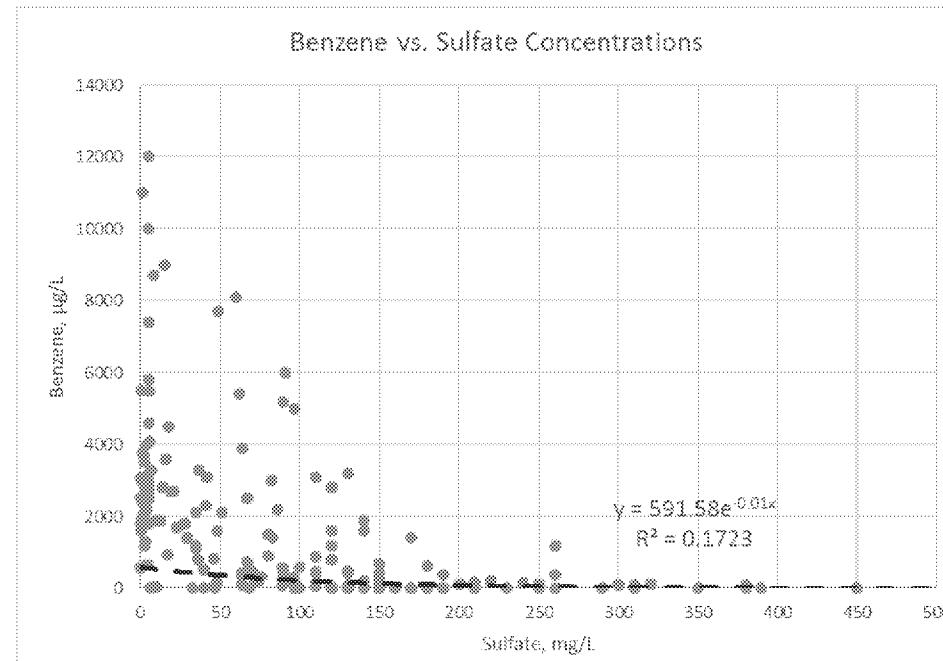
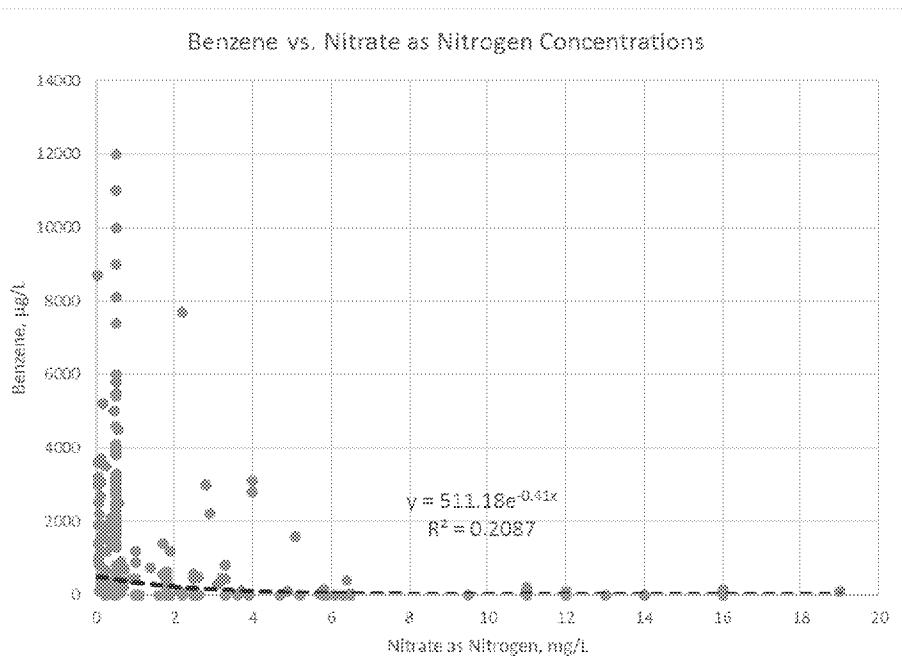
- Statistical correlation presented in Oct for nitrate-benzene and sulfate-benzene
- This update adds the other BTEX compounds (toluene, ethylbenzene, and xylenes)
- Included groundwater data for perimeter wells since Jan 2015 and interior wells since SEE through August 2018



Site ST012 Regression Analysis

Benzene

- Overall nitrate and sulfate concentrations are statistically inversely correlated with benzene concentrations
- P values, a measure of correlation, are < 0.00003 (i.e., >99.997% probability that parameters are correlated; 95% [P<0.05] is typically considered significant correlation)
- R² values (0.21 and 0.17), a measure of how well variability in the data is explained by the trendline equation, indicate variability (R²=1 is ideal prediction)

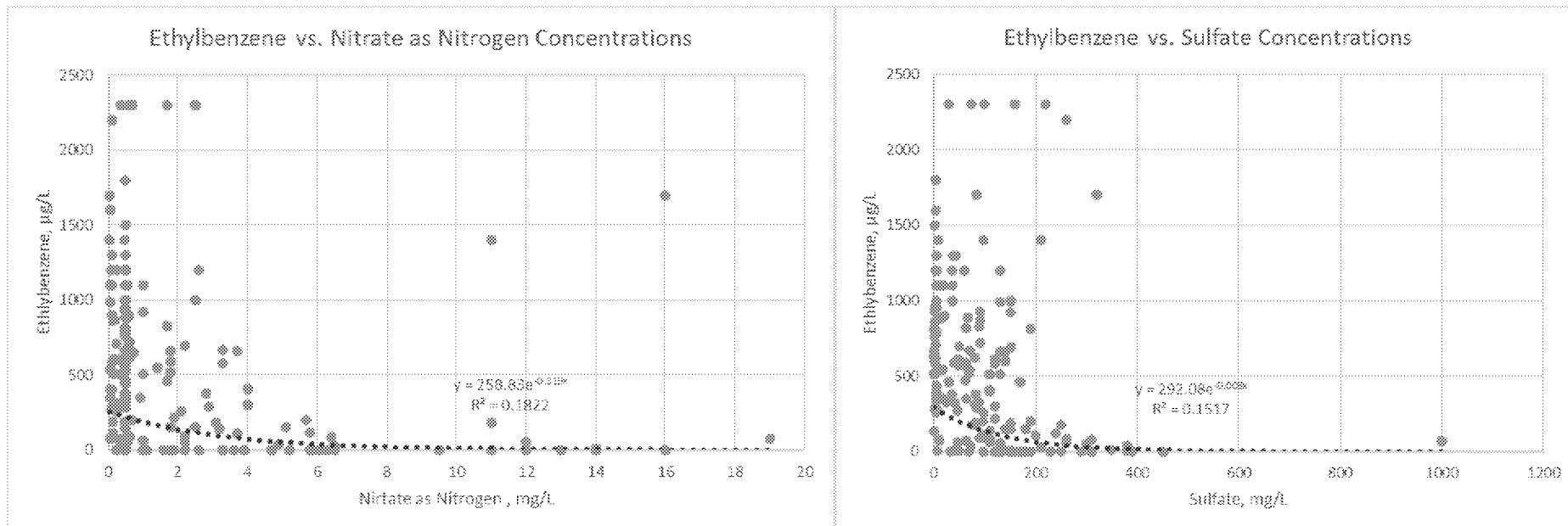




Site ST012 Regression Analysis

Ethylbenzene

- Overall nitrate and sulfate concentrations are statistically inversely correlated with ethylbenzene concentrations
- P values are < 0.0004 (i.e., >99.96% probability that parameters are correlated)
- R² values (0.18 and 0.15) indicate variability (R²=1 is ideal prediction)
- Total iron is also statistically correlated (graph not shown) (p=0.0067)

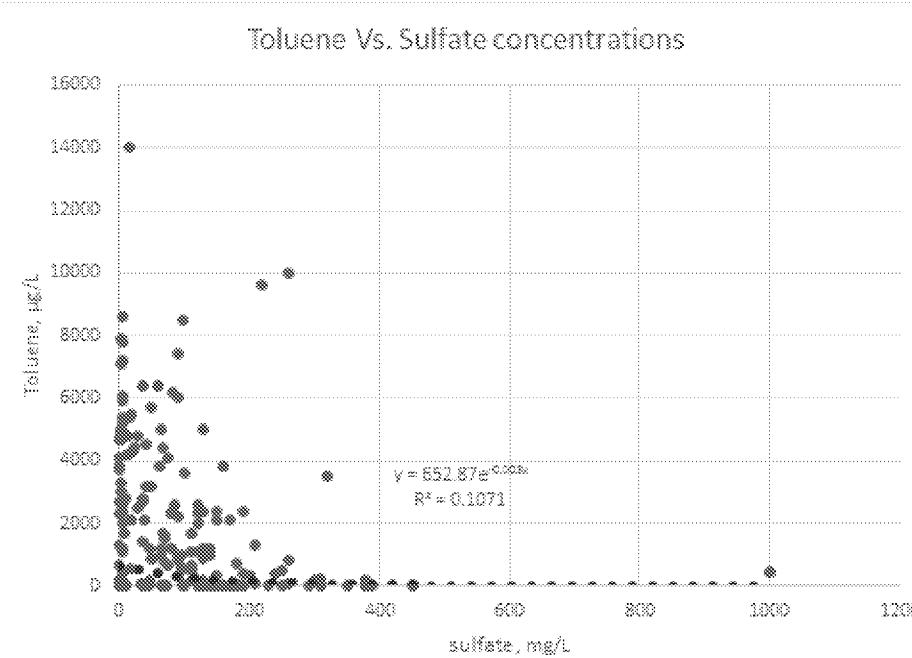
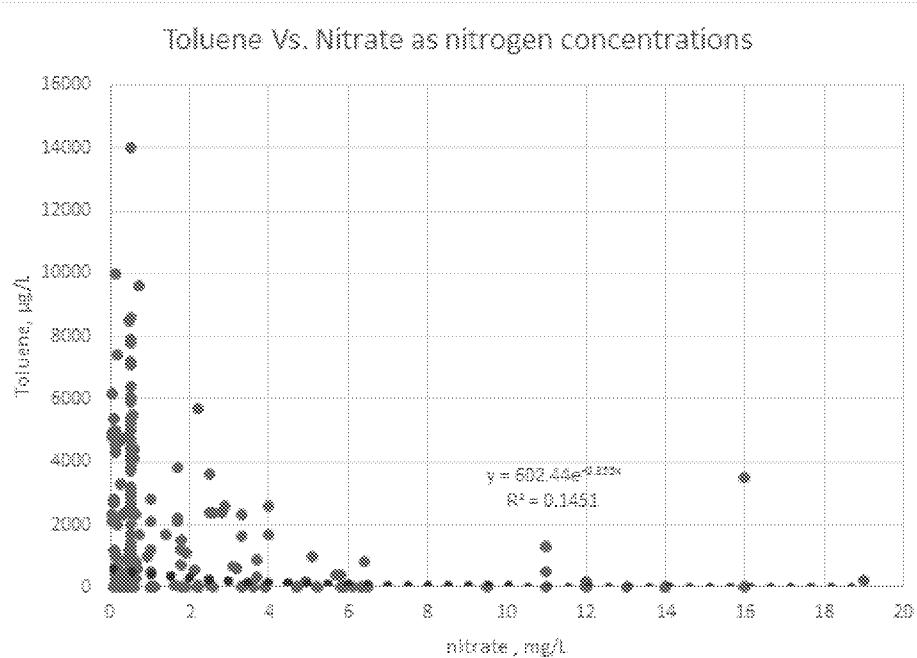




Site ST012 Regression Analysis

Toluene

- Overall nitrate and sulfate concentrations are statistically inversely correlated with toluene concentrations
- P values are < 0.00003 (i.e., >99.997% probability that parameters are correlated)
- R² values (0.15 and 0.11) indicate variability (R²=1 is ideal prediction)



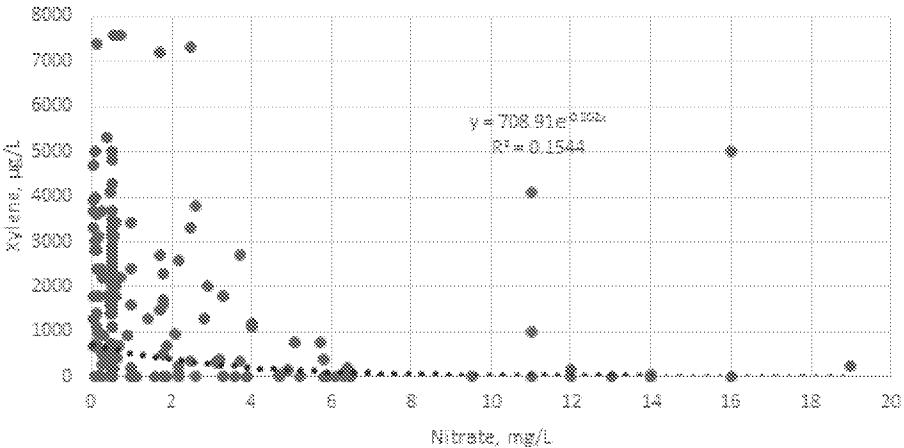


Site ST012 Regression Analysis

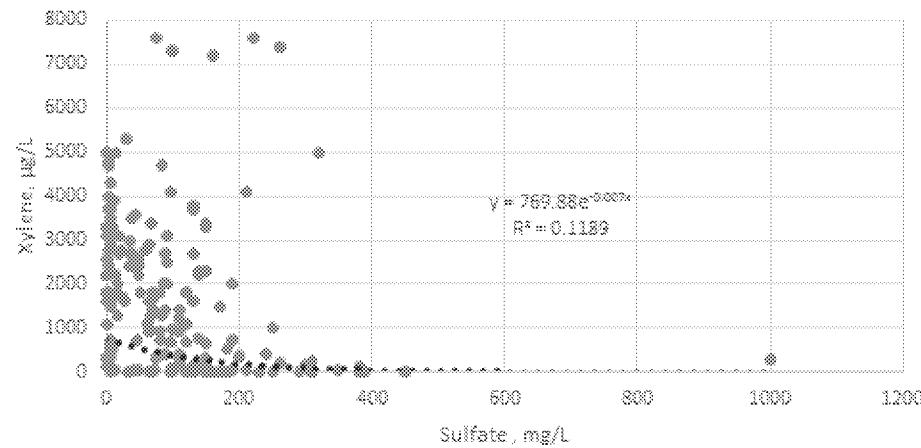
Xylenes

- Overall nitrate and sulfate concentrations are statistically inversely correlated with total xylenes concentrations
- P values are < 0.0006 (i.e., >99.94% probability that parameters are correlated)
- R² values (0.15 and 0.12) indicate variability (R²=1 is ideal prediction)
- Total iron is also statistically correlated (graph not shown) (p=0.01)

Xylenes vs. Nitrate



Xylenes vs. Sulfate





November Sampling Summary

- **Sampling included:**
 - Annual groundwater sampling locations
 - Quarterly pilot test groundwater sampling locations (those not already covered by annual locations)
 - Additional supplemental interior locations (extra samples that were not part of pilot study implementation work plan) to check for changes in magnitude of
- **General Observations**
 - No change in estimated 5 µg/L benzene contours
 - Most interior sample concentrations are reduced from previous result



Preliminary November Groundwater Sampling Results

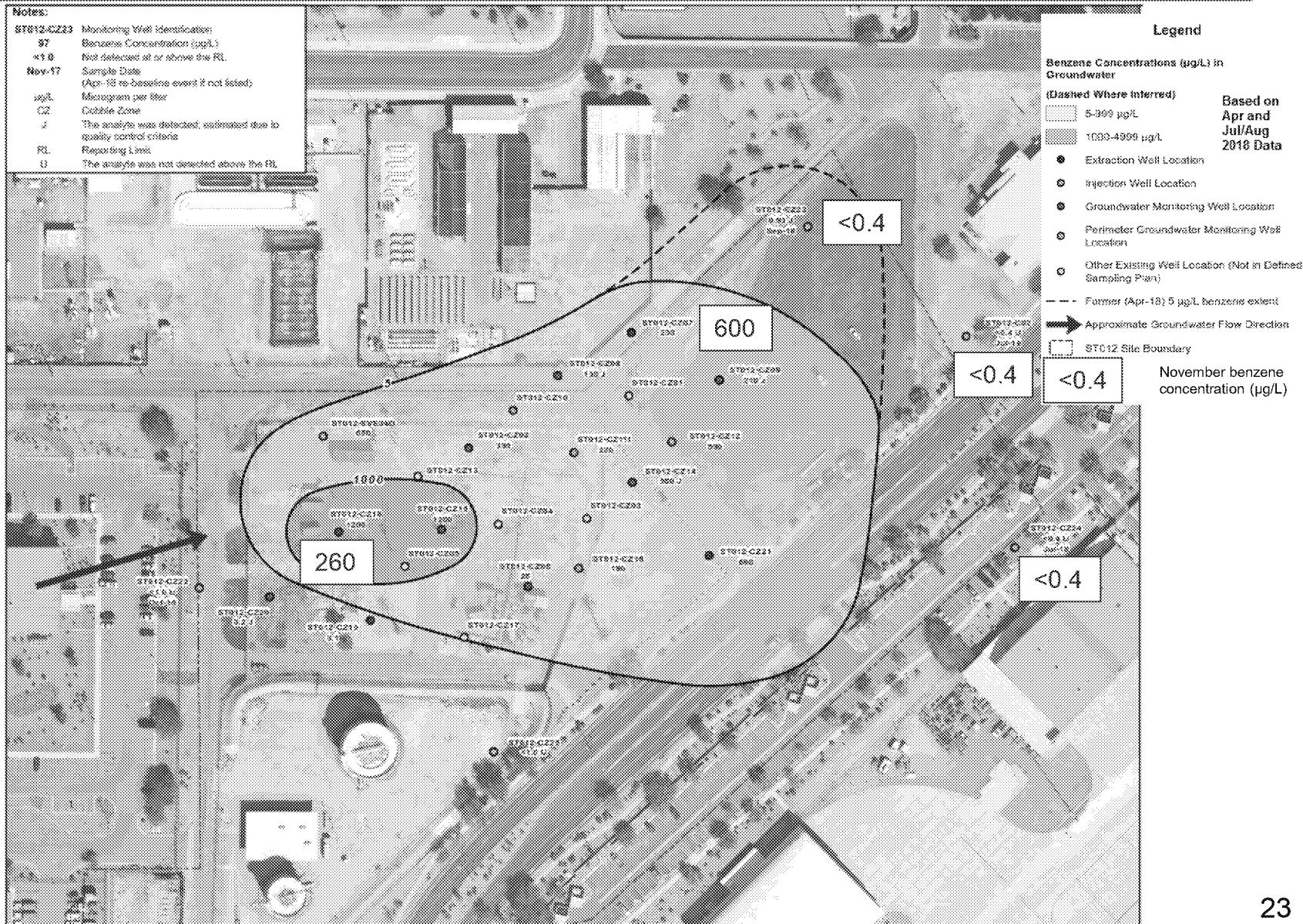


November Sampling Summary

- **Sampling included:**
 - Annual groundwater sampling locations
 - Quarterly pilot test groundwater sampling locations (those not already covered by annual locations)
 - Additional supplemental interior locations (extra samples that were not part of pilot study implementation work plan)
 - To check for changes in magnitude of benzene concentrations in select interior locations
- **General Observations**
 - No change in estimated 5 µg/L benzene contours
 - Most interior sample concentrations are reduced from previous result



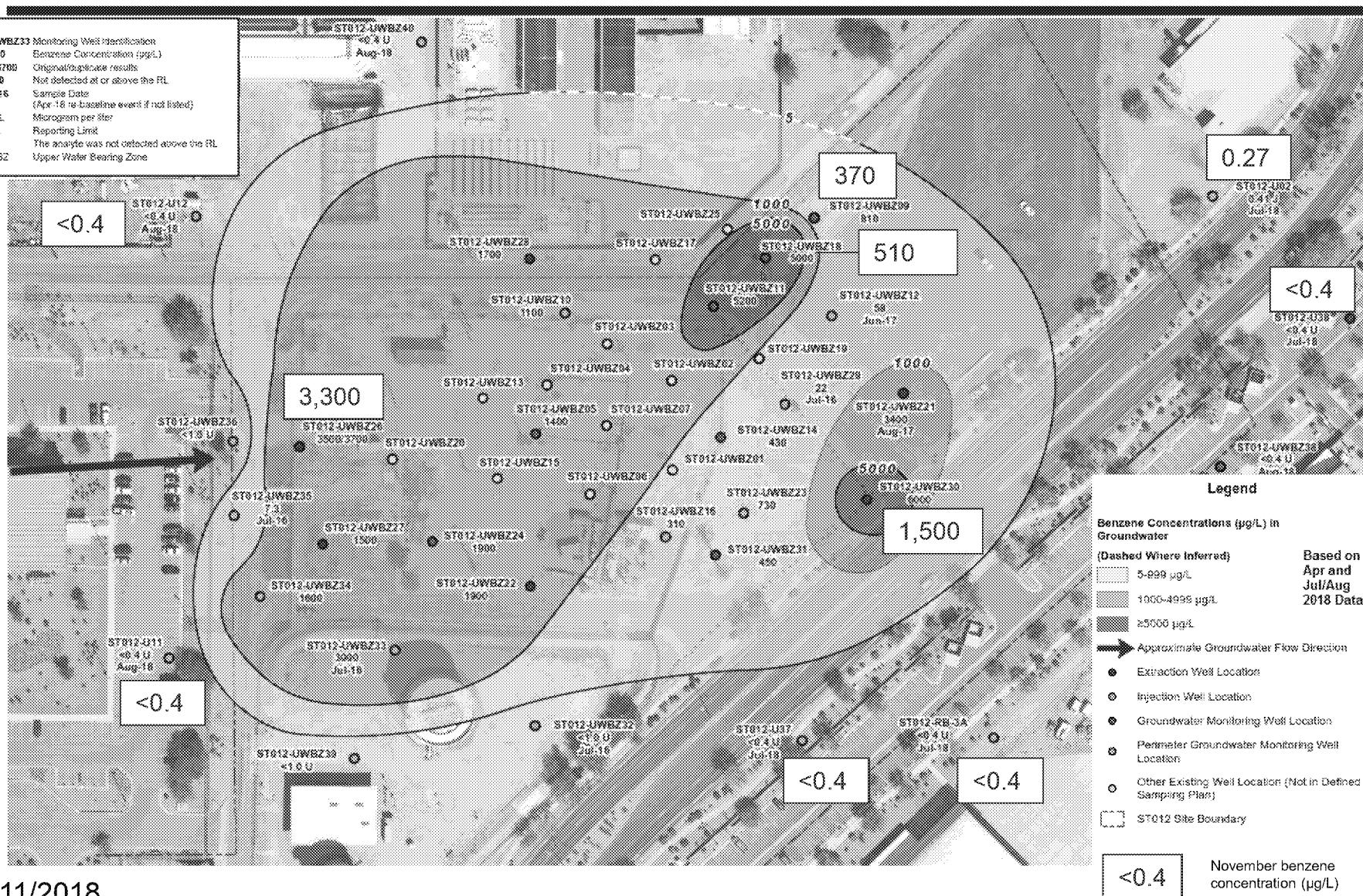
Site ST012 Annual Benzene (µg/L) in CZ (previous contours for reference)

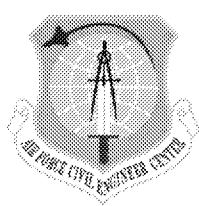




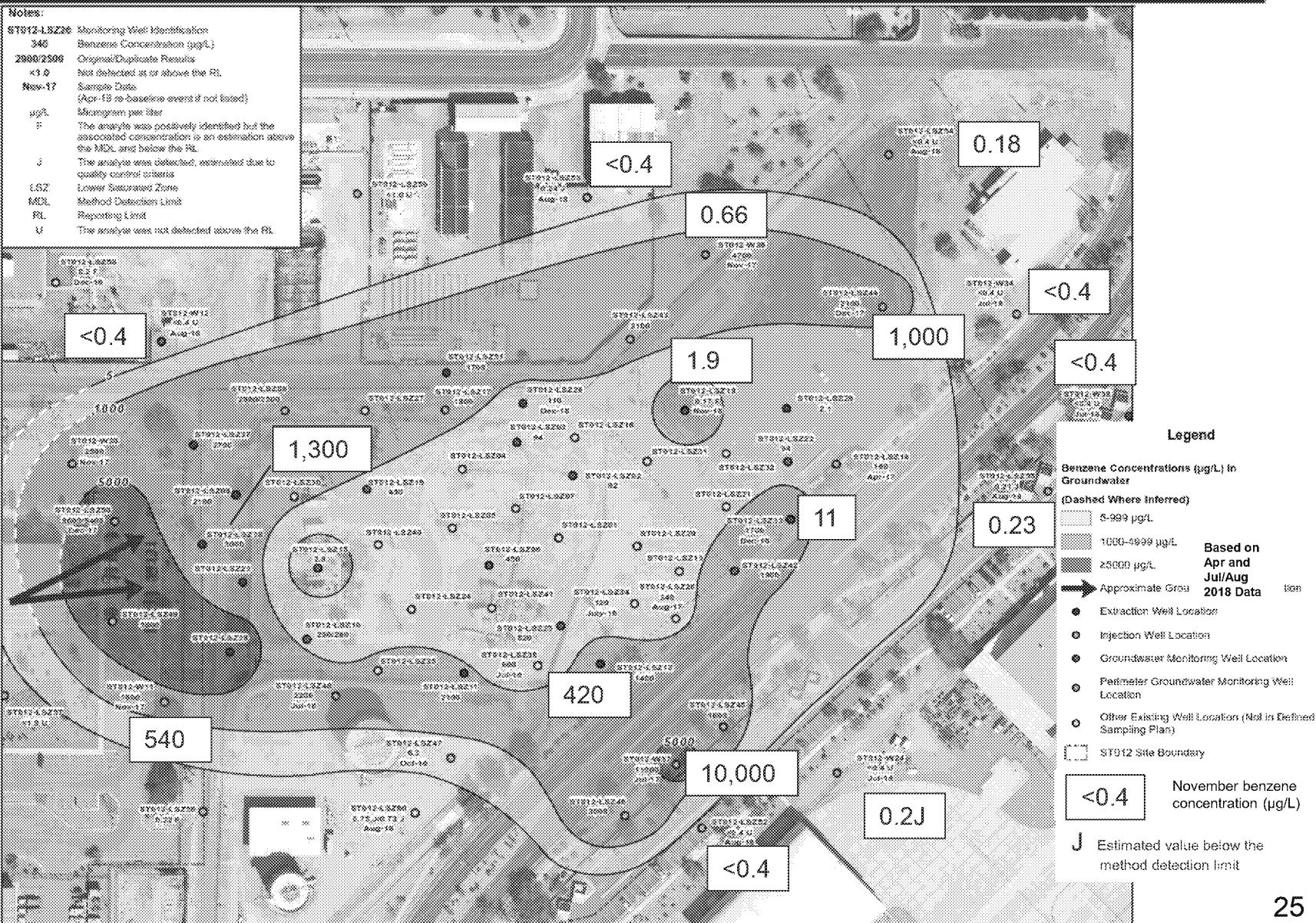
Site ST012 Annual Benzene ($\mu\text{g}/\text{L}$) in UWBZ (previous contours for reference)

Notes:
ST012-UWBZ33 Monitoring Well Identification
3200 Benzene Concentration ($\mu\text{g}/\text{L}$)
3500U32700 Original/duplicate results
<1.0 Not detected at or above the RL
JUL-18 Sample Date
(Apr-18 to baseline event if not listed)
ug/L Microgram per liter
RL Reporting Limit
U The analyte was not detected above the RL
UWBZ Upper Water Bearing Zone





Site ST012 Annual Benzene ($\mu\text{g}/\text{L}$) in LSZ (previous contours for reference)



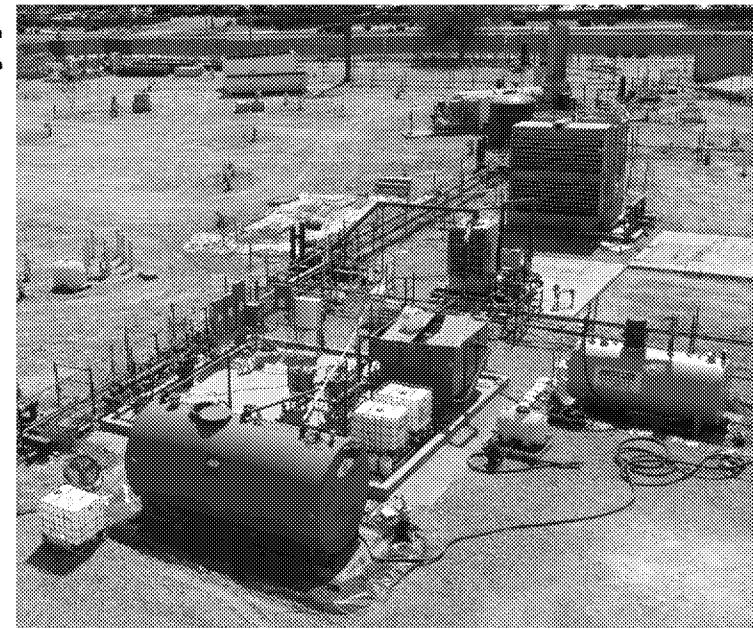
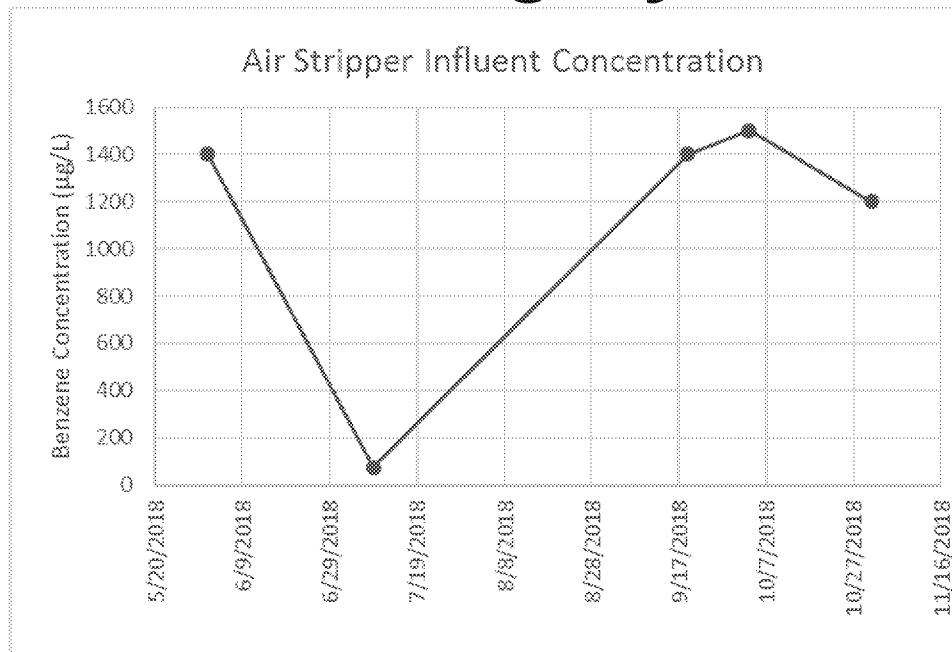


Pilot Study Injection/Extraction Update



Site ST012 Extraction System Performance

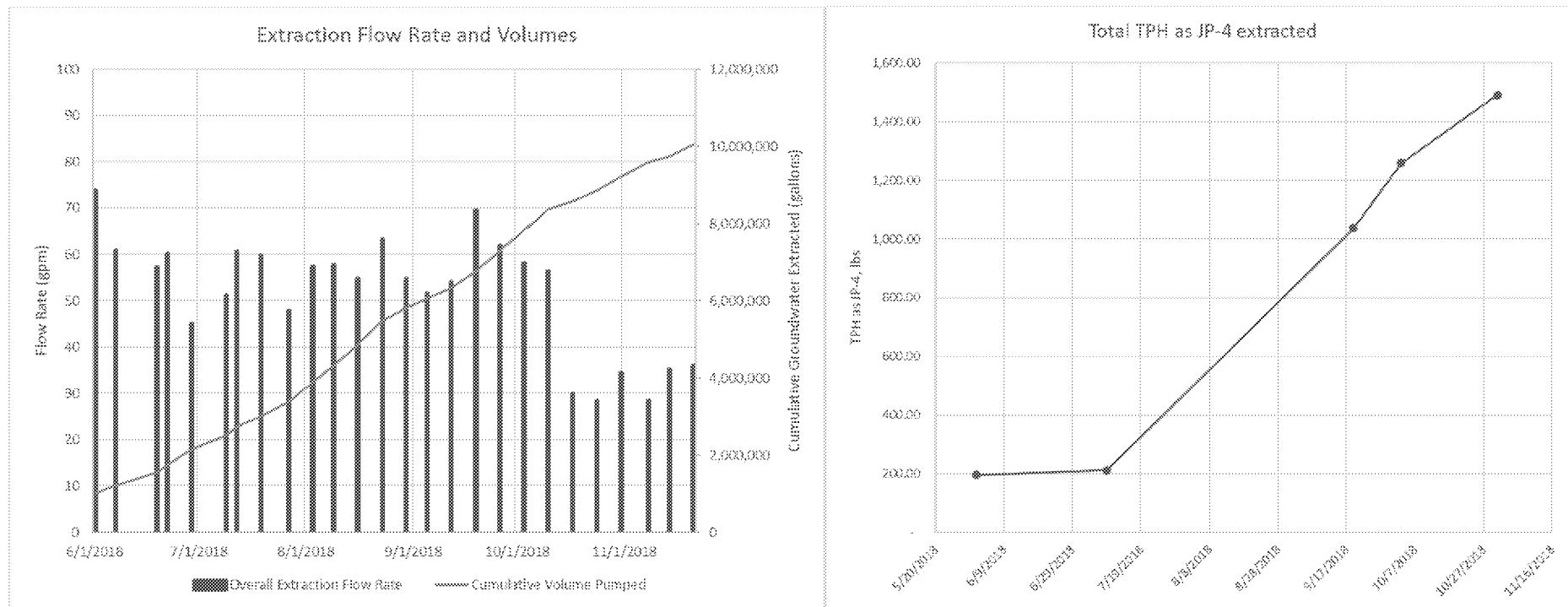
- No LNAPL has been recovered since extraction started up
- Benzene air stripper influent decreased slightly





Site ST012 Extraction System Performance

- Overall Extraction Rates and Estimated Mass Removal by Extraction

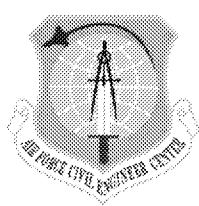




Site ST012 Injection Progress

- **First sodium sulfate batch mixed**
 - Material was caked/solidified due to storage
 - Pre-mix tank required structural improvements
 - Upgraded recirculation pumps for more robust mixing
- **Injected first batch in ST012-UWBZ33**
 - 4 Dec through 11 Dec
 - Injected at lower concentration (~50g/L)/higher volume due to caking/solubility but the planned sulfate mass injected
 - Approximate 8-10 gpm injection rate
 - Initially estimated from drop in frac tank
 - Turbine flow meters were erratic due to the pulsing action of the pneumatic injection pump
 - Replaced turbine flow meter with positive displacement totalizing water meter (similar to residential water meter)





Site ST012 Path Forward Dec-Jan

- Continued SVE operation
- Replace flame oxidizer with oxidizer from ST035 for SVE from 14 Dec – 19 Dec
- Install replacement pumps week of 17 Dec
- Reduce CZ23 sampling frequency to quarterly
- Pilot Study Implementation
 - Continue mixing sulfate batches and inject according to plan (FVM7) Dec – Mar (continuing injection of batches in UWBZ33 mid next week, subject to working around oxidizer and pump replacement activities)